

Columbia University
in the City of New York

LAMONT GEOLOGICAL OBSERVATORY
PALISADES, NEW YORK

MAGNETIC TOTAL INTENSITY
MEASUREMENTS ON LAKE ERIE

by

G. Peter and R. E. Wall

Technical Report No. 1
CU-2-61-Nonr-Geology

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ILLUSTRATIONS

FIGURE

- 1 LAKE ERIE SURVEY AREA AND TRACKS OF PORTE DOUPHINE
BETWEEN AUG. 22 AND SEPT. 2
- 2 EASTERN PART OF LAKE ERIE, SHOWING THE PROFILES
WHERE MAGNETIC MEASUREMENTS WERE OBTAINED
- 3 MAGNETIC TOTAL INTENSITY CONTOUR MAP
- 4 MAGNETIC TOTAL INTENSITY PROFILES, MADE IN THE
EASTERN PART OF LAKE ERIE

ABSTRACT

During August and September of 1960, total magnetic field intensity measurements were made on Lake Erie, as part of a geophysical program conducted, jointly, by the Lamont Geological Observatory and the Great Lakes Institute of the University of Toronto. This report presents a total magnetic intensity contour map of the main survey area, and total magnetic intensity profiles from the eastern part of the lake.

INTRODUCTION

During the summer of 1960, the Great Lakes Institute of the University of Toronto, together with the Lamont Geological Observatory, conducted a three week long geophysical survey on Lake Erie. The geophysical instruments installed on the Research Vessel, PORTE DOUPHINE, were a Proton Free-Precession Magnetometer, a Graf Sea Gravimeter and an E. G. and G. Sonar Thumper.

The purpose of this report is to present the results of the total magnetic intensity measurements. No interpretations will be made here.

GENERAL DESCRIPTION OF THE SURVEY AREA

The principal area which was covered by the geophysical program between Aug. 22 and Sept. 2 lies between the Pelee Island and the Port Burwell, Ashtabula line (see Figure 1). In this area seventeen survey lines, spaced approximately five miles apart, were run normal to the axis of the lake. Two lines were run parallel to the axis to check values on crossings. Navigation was entirely by radar fixes on adjacent land masses.

Between the days of August 15 and August 19 the hydrological and meteorological programs of the Great Lakes Institute of the University of Toronto had priority. During this period the geophysical instruments were still in the

testing stage. Figure 2 shows the eastern part of Lake Erie with the tracks of the PORTE DOUPHINE, where magnetic total intensity measurements were obtained.

MAGNETOMETER AND MAGNETIC MEASUREMENTS

A proton free-precession magnetometer was used to measure the total intensity of the magnetic field. This instrument is one of the several types which were developed and built at the Lamont Geological Observatory over the past few years for use in marine work. Reports of this instrument have been written by Luskin and Hubbard (1959), Hirshman and Luskin (1960), and Heirtzler (1961).

The accuracy of the instrument depends upon several factors which the above references discuss in detail. In this magnetic latitude and with the instrument settings used, the instrumental error was less than 0.6 gamma.

The time-varying part of the magnetic field was not removed. In this latitude, the diurnal variation in the geomagnetic field (Sq) is approximately 50 gamma (Vestine, et. al., 1947). Other time variations as evidenced by the Agincourt Magnetic Observatory, K-indices did not affect the results. Since the magnetic anomalies in this area are very localized, a small navigational error could lead to a significant error in the magnetic readings. Track crossings showed that average errors of about 50 gammas were caused by these

sources.

Other error sources, such as electronic interference, magnetic field of the vessel proved to be insignificant.

Figure 3 is the magnetic total intensity contour map. The base value (the 0 contour line) on the map is 58,000 gamma and the contouring is at intervals of 100 gammas. The notation on the contour lines (for example, +1, +2, etc.) is the number of 100 gamma units that must be added to or subtracted from the base value.

From the U.S. Hydrographic Office Chart No. 1703 of the total intensity for 1955 the regional magnetic field is found to be 7.2 gamma per mile. The width of the lake in the survey area is 30 miles, so a total intensity change of 216 gamma is expected across the lake. The removal of this regional field would make minor changes in the size and shape of the anomalies.

The magnetic measurements made on the eastern part of Lake Erie are not included in the map. The survey lines here were run fifteen miles apart and this spacing proved too great for magnetic mappings.

These measurements, however, are shown in profile form on Figure 4.

ACKNOWLEDGMENTS

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The geophysical field work was supervised by J.L. Worzel. Lamont personnel participating were; R.E. Wall, J. Houterman and T. Southworth. H. Van Santford, J. Walsky and G. Peter aided in the installation and tests of the instruments and participated in the first five days of the survey.

The authors wish to acknowledge the assistance of Professor Dean and the Great Lakes Institute of the University of Toronto making this survey possible. Special appreciation goes to the officers and crew of the PORTE DOUPHINE for their cooperation and understanding, which greatly aided the success of this survey.

We are grateful to Dr. J.R. Heirtzler, and Dr. J.L. Worzel for critically reading the manuscript, and to D. Wolfe and C. Peppin for preparing the illustrations.

REFERENCES

1. Heirtzler, J. R. (1961), Magnetic Results of the VEMA-16 Cruise (paper in preparation).
2. Hirshman, J. and Luskin, B. (1960), A Two-conductor Proton Precession Magnetometer for Marine Use (unpublished manuscript).
3. Hubbard, A. C. and Luskin, B. (1959), Sounding and Magnetometer Equipment for a Drifting Ice Station (Tech. Report #19, CU-52-59).
4. Vestine, E.H., I. Lange, L. Laporte and W.E. Scott (1947), The Geomagnetic Field, its Description and Analysis (Carnegie Institution of Washington, publ. No. 580).

Figure 2

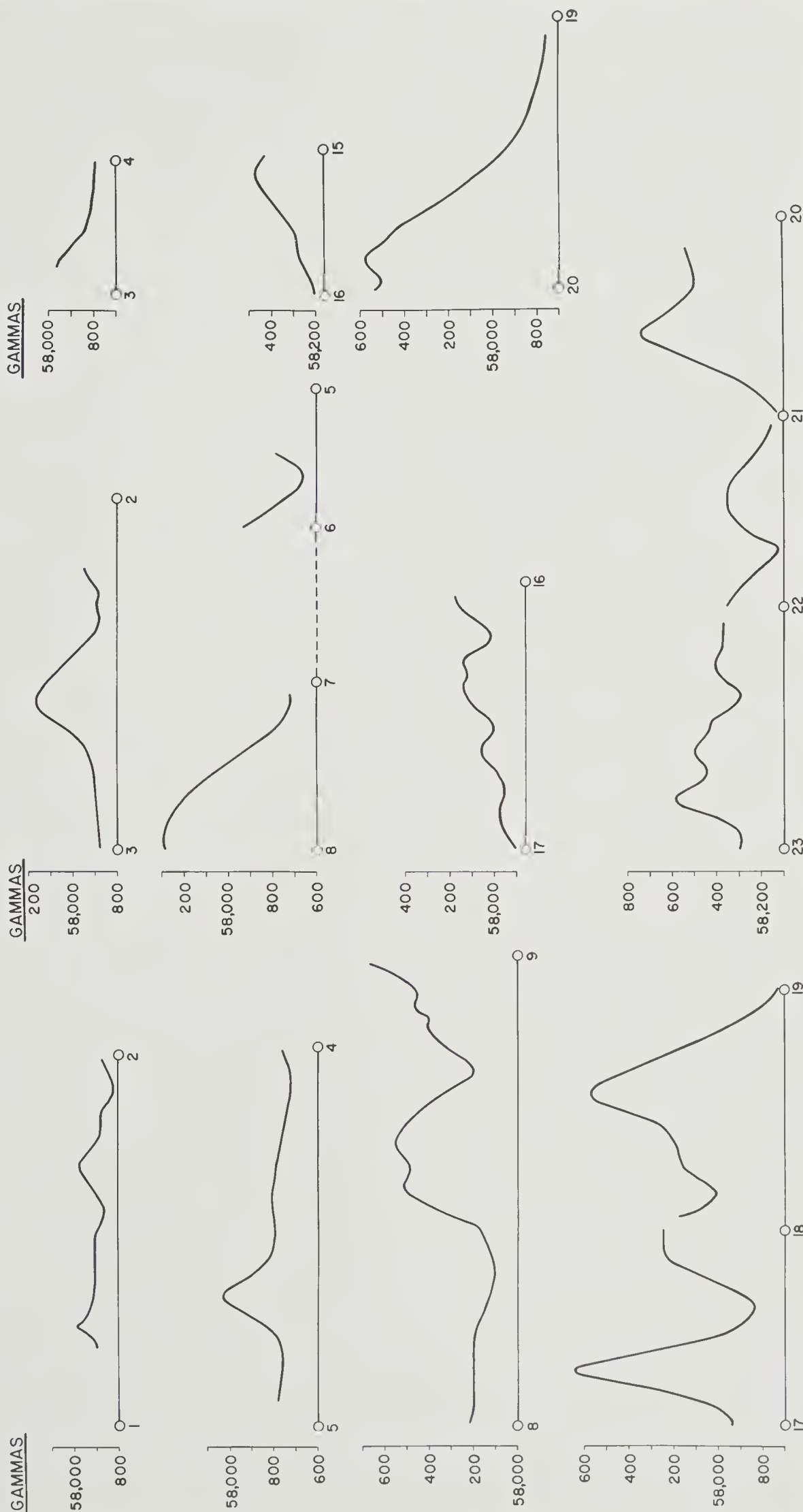


Figure 3

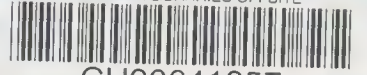


Figure 4

LAKE ERIE
MAGNETIC TOTAL INTENSITY PROFILES



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